Introduction of Complementary Foods to Premature Infants During the First Year of Life

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Abstract

Purpose and Background/Significance: During the first year of life, questions arise as to when complementary foods should be introduced to premature infants. Debate centers on whether actual age or corrected age should be used. Guidelines specify that complementary foods should be introduced between 4-6 months corrected age. Mothers are usually the decision-maker in relation to the introduction of complementary foods. What is unclear are the factors that influence maternal decision-making. The purpose of this study was to understand maternal reasoning in relation to the introduction of complementary foods to their premature infants.

Method: A secondary analysis was conducted of interview data from 21 mothers who participated in a study to understand mothers' intentions to feed their premature infants. In the original study, mothers of very low birthweight (birthweight less than 1500 grams) infants were recruited prior to discharge from the neonatal intensive care unit. Mothers were interviewed when their infants were at 1, 4, 8, and 12 months corrected age. All interviews were transcribed verbatim. Three key concepts from the Theory of Planned Behavior guided the secondary analysis of the interview data: behavioral beliefs, normative beliefs, and control beliefs.

Results: Overwhelmingly, mothers introduced complementary foods earlier than recommended. Maternal behavioral beliefs centered on the benefit to their infants. Perceived benefits included enhanced sleeping at night, improved growth, and remaining "full" longer. The influence of normative beliefs was demonstrated by strong reliance on the advice of peers including friends and relatives. Few mothers followed the Pediatrician's recommendations. Mothers' control of introducing complementary foods was influenced by interpretation of their infant's readiness cues, concern over infant hunger, and trust in their own judgement.

Conclusion: Mothers believe that they know what is best for their infant and make decisions based on this principle. Research is needed to understand why mothers readily follow the advice of peers and are reluctant to follow established guidelines.

Introduction

The period of infancy is a critical time in relation to nutritional intake. Because of the rapid growth that occurs during this period, the nutritional requirements per kilogram of body weight are higher than at any other time across the lifespan (Netting & Makrides, 2017; Young & Krebs, 2013). Importantly, the infant undergoes the necessary developmental and physiologic maturation that allows for the transition from the ability to only consume liquids (breastmilk or formula) to the ability to eat complementary foods with a variety of textures and consistencies (Netting & Makrides, 2017; Young & Krebs, 2013). Complementary foods include solid and liquid foods, other than breastmilk or infant formula, that are needed to meet nutritional requirements when milk feeds are no longer sufficient to meet these requirements (Barrera, Hamner, Perrine, & Scanlon, 2018). By the end of the first year of life, a significant portion of the infant's nutritional requirements are met by complementary food intake.

Providing nutrition to premature infants following discharge from the neonatal intensive care unit (NICU) can be a challenge for parents. Premature infants often are discharged from the NICU exhibiting feeding skills that are developmentally immature. Parents report a variety of challenges feeding their premature infant in the early post-discharge period (Boykova, 2016) as a significant number of these infants exhibit disorganized or dysfunctional feeding skills (Crapnell, Rogers, Neil, Inder, Woodward, & Pineda, 2013). Across time, parents are not only responsible for supporting the continued maturation of these evolving skills but also must make decisions related to determining when their infant is developmentally ready for the expected introduction and transition to complementary foods.

The American Academy of Pediatrics (AAP) (DiMaggio, Cox, & Porto, 2017) recommends that infants are exclusively breastfed for the first six months of life and then

complementary foods should be introduced while continuing to provide breastmilk. There is a lack of recommendations for premature infants (Palmer & Makrides, 2012). Operationalizing the AAP recommendations for infants born prematurely is not straightforward as there is a lack of specificity in taking into account the extent of the infant's prematurity. In addition, conflicting opinions are available to parents through social media and the online environment. The American Academy of Family Physicians recommends that complementary foods should be introduced to premature infants between four and six months corrected age (Gauer, Burket, & Horowitz, 2014).

The timing of introducing complementary foods, especially the early introduction, and how parents approach providing these foods can have a significant impact on the infant's overall growth and health (Braid, Harvey, Bernstein, & Matoba, 2015). While there are contrasting research results in need of further prospective study, there is concern that the early introduction of complementary foods to full-term infants may be associated with obesity (Huh, Rifas-Shiman, Taveras, Oken, & Gillman, 2011; Pearce, Taylor, & Langley-Evans, 2013), diabetes mellitus (Nucci, Virtanen, & Becker, 2015), and allergies (Grimshaw et al., 2013). However, there is minimal evidence available to address the impact of early complementary feeding on the health outcomes of premature infants (Vissers, Feskens, van Goudoever, & Janse, 2016).

Literature Review

For premature infants, mastering oral feeding during the first year of life is a complex process that is characterized by maturation of feeding skills (Pineda, 2016) allowing the infant to progress from dependence upon a liquid diet to a diet that includes complementary foods with various tastes and textures (van der Heul, Lindeboom, & Haverkort, 2015). Premature infants are at risk for feeding issues during the transition to complementary foods because of developmental

immaturity of advanced feeding skills. Parents report issues surrounding the feeding of complementary foods of various textures (den Boer & Schipper, 2013; Kmita, Urmańska, Kiepura, & Polak, 2011; Sanchez, Spittle, Slattery, & Morgan, 2016). This is especially evident in premature infants who exhibited disorganized or dysfunctional feeding skills during early infancy (Törölä, Lehtihalmes, Yliherva, Olsén, 2012). Feeding difficulties found during transition to complementary foods in the premature population include difficulty accepting new food textures or new tastes, avoiding some food textures, and holding food in the mouth (DeMauro, Patel, Medoff-Cooper, Posencheg, & Abbasi, 2011; Sanchez et al., 2016; Thoyre, 2007; Törölä et al., 2012). This can make adjustment to new foods difficult, independent of the development of oral-motor skills (Törölä et al., 2012; Hawdon, Beauregard, Slattery, & Kennedy, 2000).

Introduction of Complementary Foods

As previously stated, there are not clear guidelines for introducing complementary foods to infants born prematurely. Adding to the dilemma is the question of whether an age correction should be made to take into account the infant's prematurity; corrected age or chronological age. This is an important consideration as premature infants are a heterogeneous population because gestational age at birth can vary between 23 and 36 weeks (Palmer & Makrides, 2012). The recommendation from the American Academy of Pediatrics is that corrected age is utilized for premature infants (Engle et al., 2004). Researchers have demonstrated that understanding this concept can be difficult for parents (Chung, Lee, Spinazzola, Rosen, & Milanaik, 2014). Advice from healthcare providers may add to parental confusion. Use of corrected age versus chronological age varies among pediatricians. Pediatricians were found to recommend introduction of complementary foods at an average corrected age of 3.9 ± 2.1 months (Chung et

al., 2014) while others based their recommendations on the infant's chronological age (D'Agostino, Gerdes, Hoffman, Manning, Phalen, & Bernbaum, 2013).

Because of a lack of clear guidelines and consensus among healthcare providers, the age at which complementary foods are introduced to the premature population is variable. Several researchers found that complementary foods are introduced at an earlier age for a significant number of premature infants when compared to full-term infants, most often before four months corrected age (Jonsson, Van Doorn, & Van Den Berg, 2013; Törölä et al., 2012; van der Heul et al., 2015). In one study, two-thirds of premature infants were introduced to complementary foods before four months corrected age (Braid et al., 2015). This is in contrast to researchers who demonstrated in a nationally representative sample that 16.3% of full-term infants began complementary foods before 4 months of age (Barrera et al., 2018). Of importance, gestational age at birth appears to play a role with rates of early introduction higher for the most gestationally immature (Braid et al., 2015; Fanaro, Borsari, & Vigi, 2007; Norris, Larkin, Williams, Hampton, & Morgan, 2002; Spiegler et al., 2015). This may be a reflection of mothers using chronological age as a guide as opposed to corrected age. Given the disparity in the timing of introducing complementary foods, it is important to understand why mothers are introducing complementary foods to their premature infants before the infants may be physiologically and developmentally ready.

Maternal Decision-Making

Few researchers have examined maternal reasoning related to the timing of introducing complementary foods in the premature population. Caring for a prematurely born infant is a stressful experience for mothers. From the time of NICU hospitalization and throughout the first year of life, nutrition and growth are a central focus of both the mothers and healthcare

providers. Mothers report that their lives often revolve around ensuring their premature infants receive adequate nutritional intake (Lutz, 2012). Thus, concerns for growth can motivate mothers to introduce complementary foods early as a means of improving growth. Researchers demonstrated that a lower obtained body weight was related to introducing complementary foods prior to four months corrected age in premature infants (Fanaro et al., 2007; Norris et al., 2002). Törölä et al. (2012) further found that poor weight gain was the primary reason complementary foods were introduced early. Concerns over their infant's weight gain motivated mothers of full-term infants to introduce complementary foods early (Brown & Rowan, 2016; Clayton, Li, Perrine, & Scanlon, 2013; Walsh, Kearney, & Dennis, 2015).

Because of the limited evidence surrounding the decision-making underlying the introduction of complementary foods to premature infants, research focused on full-term infants offers potential insight into what factors may motivate the timing of complementary foods to premature infants. The maternal reasoning for providing deciding to introduce complementary foods early are varied. The most commonly reported reasons included perceptions the infant frequently appeared hungry (Arden, 2010; Brown & Rowan, 2016; Clayton et al., 2013; Tarrant, Younger, Sheridan-Pereira, White, & Kearney, 2010), perceptions that infants needed something more than breastmilk or infant formula (Doub, Moding, & Stifter, 2015), promoting longer periods of sleep at night (Arden; Brown & Rowan; Clayton et al.; Tarrant et al.), pressure from family or friends (Arden; Brown & Rowan; Moore, Milligan, Rivas, & Goff, 2012), and encouragement by a pediatrician or healthcare provider (Arden; Clayton et al.; Moore et al.). One could hypothesize that similar reasons drive the decision-making of mothers of premature infants. Feeding a premature infant can be a stressful experience across the first year of life and more uncertainty surrounds feeding these vulnerable infants when compared to full-term infants

(DeMauro et al., 2011; Törölä et al., 2012). Importantly, early introduction of complementary feedings in premature infants before they are developmentally ready have the potential to result in feeding problems during later infancy (Chung, et al., 2014).

Summary

Complementary foods are being introduced earlier in premature infants than in full-term infants (Braid et al., 2015; Jonsson et al., 2013; Törölä et al., 2012). Confusion continues to arise from discrepancies between the use of corrected age and chronological age for premature infants, especially when considering introduction of complementary foods (Chung et al., 2014; D'Agostino et al., 2013). Ultimately, it is the mother who decides when she introduces complementary feedings to her premature infant. However, there is little research on the driving factors involved in the mother's crucial decision. Because mothers often assume primary responsibility for feeding their premature infant, the purpose of this study was to understand maternal reasoning in relation to the introduction of complementary foods to their premature infants. In addition, there was interest in examining the infants' pattern of growth across the first year of life.

Methods

This study was conducted as a secondary analysis of interview data from a longitudinal study (Pridham, Brown, Sondel, Clark, & Green, 2001). In the original study, data were obtained in the infant's home at 1, 4, 8, and 12 months corrected age. These stages were selected, as they are ages when infants reach specific developmental milestones. During the visits, mothers were videotaped feeding their infant and then debriefed and interviewed while watching the video. In these interviews, mothers described their decision-making process and influences related to infant feeding. For this secondary analysis, eligibility for further analysis was determined by a

review of the interview transcripts for a discussion of complementary foods. Twenty-one mothers discussed complementary foods. These interviews were subjected to further analysis.

Participants were recruited prior to discharge from three Neonatal Intensive Care Units (NICU) located in the Midwestern United States. All mothers selected were 18 years of age or older, English speaking, and able to read. Infants in the study were born prematurely at 32 weeks or less gestational age with a birthweight that was appropriate for gestational age (AGA). Infants selected had either Respiratory Distress Syndrome (RDS) or Bronchopulmonary Dysplasia (BPD). RDS was defined with radiologic evidence. BPD was defined as the need for supplemental oxygen at 28 days of life, as well as radiologic evidence of a chronic lung disease (de Regnier et al., 1996; Farrell & Palta, 1986).

The Theory of Planned Behavior was selected to guide analysis of the interview data because the theory's main construct is directed towards understanding an individual's intentions to perform a specific behavior (Ajzen, 1991). Three concepts underpin the Theory of Planned Behavior; attitudes towards the behavior, subjective norms, and perceived behavioral control. Attitudes towards a specific behavior refers to the degree to which an individual holds a positive or negative appraisal of the intended behavior. Subjective norm refers to how an individual perceives the social pressures to perform the intended behavior. Perceived behavioral control refers to how the individual perceives the ease or difficulty in performing the intended behavior (Ajzen, 1991).

Specific to this secondary analysis, understanding the intentions of mothers of premature infants surrounding complementary foods, especially the initial introduction of these foods, is critical given the high percentage of premature infants experiencing early introduction of complementary foods. The three concepts of the theory were further defined *a priori* for this

analysis and provided the thematic categories for organizing the maternal interview data; the mothers' attitudes towards complementary foods, influence of beliefs of significant others on the mothers' beliefs, and the mothers' perceived control over the introduction of complementary foods (Duncanson, Burrows, Holman, & Collins, 2013). All interviews were analyzed by two reviewers.

Results

The interviews of 21 mother-infant dyads met the inclusion criteria and were analyzed. The mean maternal age was 29.1 ± 5.9 years with the mothers completing 13.5 ± 1.5 years of education. The mean gestational age at birth was 27.6 ± 1.5 weeks with a mean infant birthweight of 1070.7 ± 209.2 grams. There were 12 males and 9 females among the dyads.

Mothers' Attitudes Towards Complementary Foods. The majority of mothers introduced complementary foods earlier than recommendations, with 71% of mothers introducing complementary foods prior to 4 months corrected age. Common themes regarding the reasoning for introducing complementary foods emerged. Mothers believed that it would enhance their infant's sleeping patterns. A significant number of mothers believed that early introduction of complementary foods would improve their infant's growth. This theme is reflected in the following comments:

> *"…she needs the weight behind her, she needs to have something more solid in her stomach…"*
>
> *"…doesn't seem like he is losing weight and I am not concerned about it because he is getting cereal and juice…"*
>
> *"…trying to feed her as many calories as we can a day between the formula and the cereal and hopefully she'll just gain weight…"*

Mothers also believed that complementary foods would increase the length satiety for their infants. As one mother stated:

"…milk doesn't seem to fill him up for a long amount of time…"

Mothers also frequently stated that introducing complementary foods to their infant would normalize their eating habits.

Influence of Beliefs of Significant Others. Subjective beliefs include the external influences that mothers valued the most when considering the appropriate time to introduce complementary foods. Analyzation of the data demonstrated that mothers most often listened to advice from their friends and relatives when deciding when and how to introduce complementary foods. Few mothers solely listened to the recommendations of the pediatrician. As a few mothers explained:

"…I figured if they are giving her vaccinations at birth wise 3 months, she's going to start having her cereal…"

"…I know a couple people who have come to me and said…not sleeping well at night…give some baby cereal…"

"…I don't seem to get an answer…I don't know what he's supposed to really be eating…" (Regarding asking pediatrician about what infant should be eating)

Mothers' Perceived Control. This theme focused on the mothers' beliefs regarding her perceived control over her infant's feeding habits. This perception of control was influenced by the cues exhibited by their infants, including hunger and satiety cues, and how the mothers interpreted these cues. Mothers' trusted their own judgement related to knowing their infant's needs. This trust influenced the level of their perceived control. A majority of the mothers

believed that they maintained control over the introduction and feeding of complementary foods. Mothers reported that:

> *"…he likes eating and I know he's just a normal kid and I feel a lot more relaxed about feedings now than I used to feel…"*
>
> *"…I feel that I'm sort of over controlling in my role right now…"*
>
> *"…I go for maximum intake…"*
>
> *"…I don't want her to skip meals or not have meals, she doesn't have extra fat on her…"*

And as one mother described in relation to feeding complementary foods:

> *"Basically just to get nutrition into them, it's not a bonding time because Rachel's more interested in everything else. It's not quiet time because she's moving constantly, so it's just to get her nutritional intake."*

Complementing the analysis of the interview data was an analysis of the infant's growth during the first year of life, corrected for age. *Z-scores* of the infants' weights were calculated at the corrected ages of 1, 4, 8, and 12 months. At 1 month corrected age, the *z-score* was -0.77. The *z-score* increased to -0.63 at 4 months corrected age. This increase demonstrates an improvement in the infants' growth. At 8 months corrected age, the *z-score* decreased to a value of -0.90 and is less than the *z-score* obtained at 1 month corrected age. It is important to acknowledge that the majority of infants had received complementary foods before 4 months corrected age. Z-*scores* continued to decline at 12 months corrected age with a value of -1.00. (See Figure 1).

Discussion

The purpose of this secondary analysis was to determine the reasoning mothers of premature infants use when introducing and offering complementary foods. The Theory of Planned Behavior was used as an organizing framework to analyze the interview data since its premise is to understand the intentions of an individual. Understanding the decision-making of this group of mothers will allow for the development of recommendations. A significant number of mothers in the current study introduced complementary foods to their premature infant prior to four months corrected age. These findings are consistent with the literature where mothers of premature infants were found to introduce complementary foods at an average corrected age of 1.5 to 3.5 months (Jonsson et al., 2013; Spiegler et al., 2015; Törölä et al., 2012; van der Heul et al., 2015). Braid et al. (2015) reported that approximately 65% of premature infants in their study were introduced to solid foods before 4 months corrected age. The demonstrated early introduction of complementary foods supports the need to understand why mothers of premature infants are making these decisions.

The explanations provided by the mothers in this study were similar to those of mothers of full-term infants and included perceived hunger, need for more sleep, and improved satiety. One factor, unique to premature infants, that may play a role in maternal decision-making is the use of chronological age versus corrected age. The premature infants in this study had a mean gestational age at birth of 27.6 weeks. While mothers were not specifically asked the question, mothers may have been influenced by their infant's age in weeks from birth versus age from term. Since their infants were gestationally immature, their infants had an increased chronological age. This is consistent with findings from previous research where infants with the greatest age from birth were introduced to complementary foods at an earlier corrected age (Fanaro et al., 2007; Norris et al., 2002). Understanding the importance of correcting their

infant's age for the degree of prematurity is a difficult concept for parents to understand (Chung et al., 2014). Unfortunately, healthcare providers do not always use corrected age as a standard (D'Agostino et al., 2013) thereby contributing to maternal uncertainty.

Promoting the weight gain of their infant was a primary reason for the early introduction of complementary foods. These findings are similar to Törölä et al. (2012) who found that poor weight gain was the primary reason complementary foods were introduced early. This is not unexpected. From the time preparation for discharge from the NICU begins, mothers are taught about the importance of growth and the critical role nutritional intake plays. This perception, held by both mothers and healthcare providers, continues into the home environment. Thus, mothers are vigilant about their infant's nutritional intake and growth. Issues surrounding feeding and the subsequent impact on growth are the most common complaints among mothers of premature infants followed in a NICU follow-up clinic (Bockli, Andrews, Pellerite, & Meadow, 2014) and is a common reason for readmission to the hospital (Escobar et al., 2005). Thus, growth monitoring and nutritional management are two of the most common services provided in NICU follow-up clinics (Kuppala, Tabangin, Haberman, Steichen, & Yolton, 2012). In addition, mothers view their infant's positive growth as an indicator of their competency as a mother in caring for their infant in the home environment (Browne & Ross, 2011; González & Espitia, (2014). Thus, promoting weight gain is an important motivation for mothers of premature infants.

The uncertainty of when to introduce complementary foods is impacted by from whom mothers choose to obtain information. Mothers in this study were mainly influenced by advice from family and friends. Very few mothers solely adhered to the advice of the Pediatrician. These findings are consistent with research findings derived from mothers of full-term infants.

Family and peer groups were found to significantly contribute to the early introduction of complementary foods in full-term infants as well as the use of the internet and books as information sources (Walsh et al., 2015). While the mothers in the current sample only mentioned family and friends as their primary source of advice, researchers have demonstrated that mothers of premature infants report consulting multiple external resources for guidance in caring for their infants (Murdoch & Franck, 2011). Given the vulnerability of premature infants, it is concerning this group of mothers is relying largely on the advice of family and friends and not the Pediatrician to make nutrition decisions. This may be a reflection of the frustration expressed by mothers in relation to the perceived inadequate knowledge possessed by primary care providers in managing the unique needs of premature infants (Boykova, 2016).

The decline in the z-scores across the first year of life may be reflective of the detrimental effects of early introduction of complementary foods to the infants since the majority of mothers introduced these foods before 4 months corrected age. While premature infants do not grow as well as full-term infants during the first year of life, the relationship between complementary foods and growth has not been prospectively evaluated in premature infants. The risk with the early introduction of complementary foods is the offering of foods that are not nutritionally dense (Fanaro et al., 2007) and prevents the infants from receiving the maximum nutritional benefit afforded through breast milk or infant formula, especially if fortified with specific nutrients (D'Agostino et al., 2013).

Conclusions

Mothers of premature infants introduce complementary foods before their infant may be developmentally ready. This has important ramifications for the infants. Feeding skills have been found to be delayed even when corrected for age and this immaturity coupled with the early

introduction of complementary foods may result in feeding issues throughout the first year of life that may be reflected in the growth of the infants (Ross & Browne, 2013). Continued research is needed to understand maternal decision-making surrounding complementary foods. In addition, it has been recommended that complementary foods be introduced when the premature infant exhibits signs of readiness. However, there is a lack of consensus in relation to signs of readiness in premature infants (King, 2009; Palmer & Makrides, 2012). Thus, further research is needed in this area in order to guide mothers in assessing their infant's readiness for introducing and advancing complementary foods.

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Figure 1. Pattern of Weight Gain